Judiciary Committee Meeting

HB 4209, HB 4210

April 30, 2015

1. The MMA as passed by the voters in 2008
2. 1978 PA 368, MCL333.7106
3. Congressional Research Service Report, Medical Marijuana. April 2010
4. Congressional Research Service Report, Medical Marijuana, April 2015
5. University of Toronto Driving study, 1999
6. The effect of Cannabis compared with Alcohol on Driving 2010
7. World Anti-Doping Agency, May 2013
8. SB 72 of 2015

Presented by Steven Sharpe

Assistant Executive Director of MINORML

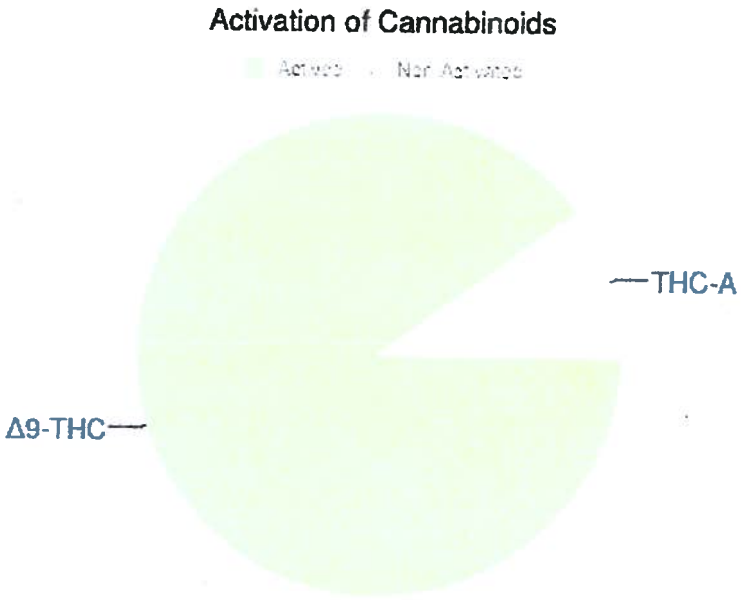
IRON LABORATORIES

Steve Sharp

TESTED: 2013-02-13
EXPIRATION: 2013-03-13
QUALITY SEAL

Test Information:

Sample:	JC3
Member:	Chocolate 1
Machine:	HPLC
Method:	UN 2009

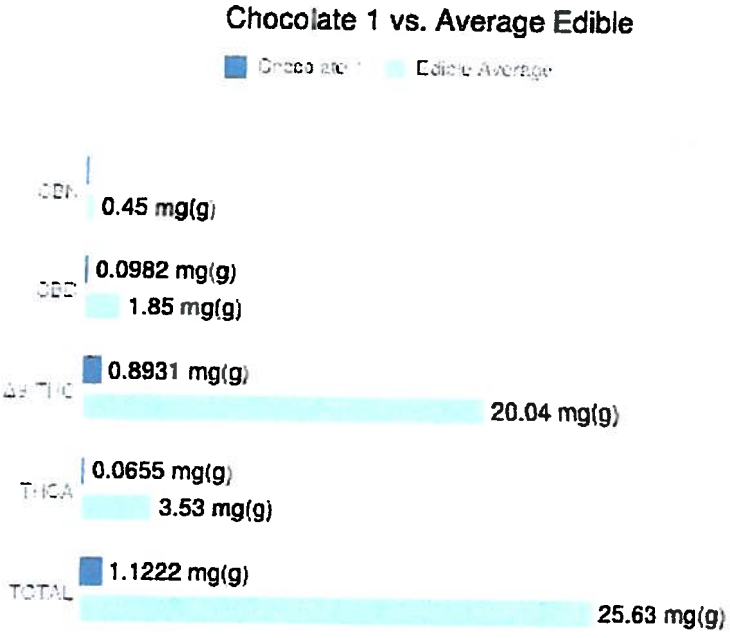


Edible Information:

Serving Size:	2.50 g
Activation:	93.00 %

Cannabinoids Profile:

THC-A	0.1638 mg/srv	0.0655 mg/g
Δ9-THC	2.2328 mg/srv	0.8931 mg/g
CBD	0.2455 mg/srv	0.0982 mg/g
CBN	0.1635 mg/srv	0.0654 mg/g
TOTAL	2.8055 mg/srv	1.1222 mg/g

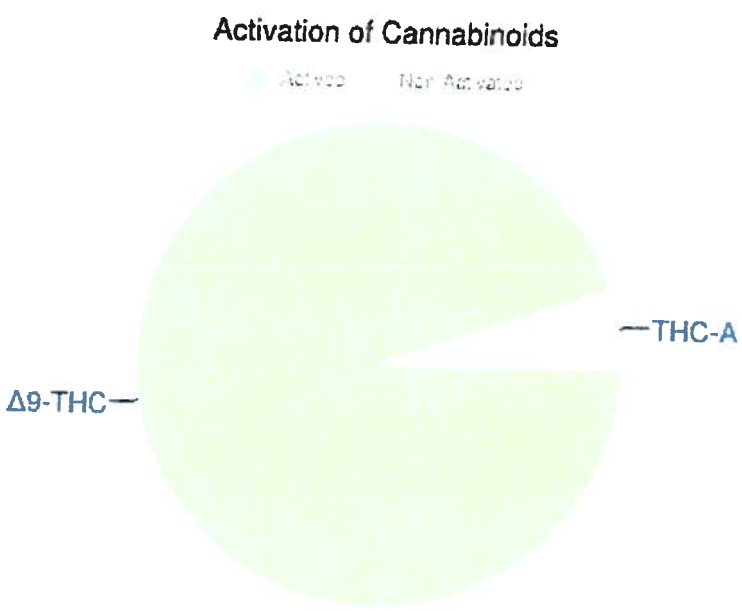


IRON LABORATORIES

TESTED: 2013-02-13
EXPIRATION: 2013-03-13
QUALITY SEAL

Test Information:

Sample:	JC3
Member:	Chocolate 2
Machine:	HPLC
Method:	UN 2009

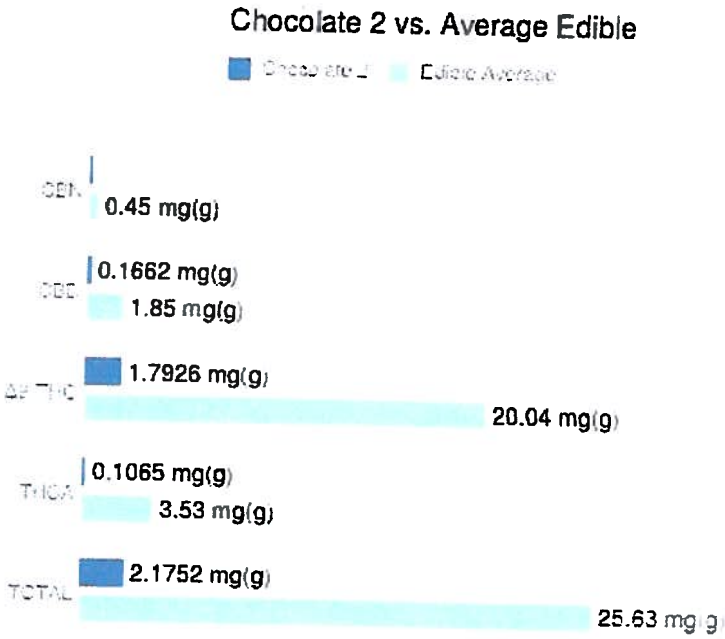


Edible Information:

Serving Size:	4.75 g
Activation:	94.00 %

Cannabinoids Profile:

THC-A	0.5059 mg/srv	0.1065 mg/g
Δ9-THC	8.5149 mg/srv	1.7926 mg/g
CBD	0.7895 mg/srv	0.1662 mg/g
CBN	0.5220 mg/srv	0.1099 mg/g
TOTAL	10.3322 mg/srv	2.1752 mg/g



MICHIGAN MEDICAL MARIHUANA ACT (EXCERPT)
Initiated Law 1 of 2008

333.26423 Definitions.

3. Definitions.

Sec. 3. As used in this act:

(a) "Bona fide physician-patient relationship" means a treatment or counseling relationship between a physician and patient in which all of the following are present:

(1) The physician has reviewed the patient's relevant medical records and completed a full assessment of the patient's medical history and current medical condition, including a relevant, in-person, medical evaluation of the patient.

(2) The physician has created and maintained records of the patient's condition in accord with medically accepted standards.

(3) The physician has a reasonable expectation that he or she will provide follow-up care to the patient to monitor the efficacy of the use of medical marihuana as a treatment of the patient's debilitating medical condition.

(4) If the patient has given permission, the physician has notified the patient's primary care physician of the patient's debilitating medical condition and certification for the use of medical marihuana to treat that condition.

(b) "Debilitating medical condition" means 1 or more of the following:

(1) Cancer, glaucoma, positive status for human immunodeficiency virus, acquired immune deficiency syndrome, hepatitis C, amyotrophic lateral sclerosis, Crohn's disease, agitation of Alzheimer's disease, nail patella, or the treatment of these conditions.

(2) A chronic or debilitating disease or medical condition or its treatment that produces 1 or more of the following: cachexia or wasting syndrome; severe and chronic pain; severe nausea; seizures, including but not limited to those characteristic of epilepsy; or severe and persistent muscle spasms, including but not limited to those characteristic of multiple sclerosis.

(3) Any other medical condition or its treatment approved by the department, as provided for in section 6(k).

(c) "Department" means the department of licensing and regulatory affairs.

(d) "Enclosed, locked facility" means a closet, room, or other comparable, stationary, and fully enclosed area equipped with secured locks or other functioning security devices that permit access only by a registered primary caregiver or registered qualifying patient. Marihuana plants grown outdoors are considered to be in an enclosed, locked facility if they are not visible to the unaided eye from an adjacent property when viewed by an individual at ground level or from a permanent structure and are grown within a stationary structure that is enclosed on all sides, except for the base, by chain-link fencing, wooden slats, or a similar material that prevents access by the general public and that is anchored, attached, or affixed to the ground; located on land that is owned, leased, or rented by either the registered qualifying patient or a person designated through the departmental registration process as the primary caregiver for the registered qualifying patient or patients for whom the marihuana plants are grown; and equipped with functioning locks or other security devices that restrict access to only the registered qualifying patient or the registered primary caregiver who owns, leases, or rents the property on which the structure is located. Enclosed, locked facility includes a motor vehicle if both of the following conditions are met:

(1) The vehicle is being used temporarily to transport living marihuana plants from 1 location to another with the intent to permanently retain those plants at the second location.

(2) An individual is not inside the vehicle unless he or she is either the registered qualifying patient to whom the living marihuana plants belong or the individual designated through the departmental registration process as the primary caregiver for the registered qualifying patient.

(e) "Marihuana" means that term as defined in section 7106 of the public health code, 1978 PA 368, MCL 333.7106.

(f) "Medical use" means the acquisition, possession, cultivation, manufacture, use, internal possession, delivery, transfer, or transportation of marihuana or paraphernalia relating to the administration of marihuana to treat or alleviate a registered qualifying patient's debilitating medical condition or symptoms associated with the debilitating medical condition.

(g) "Physician" means an individual licensed as a physician under Part 170 of the public health code, 1978 PA 368, MCL 333.17001 to 333.17084, or an osteopathic physician under Part 175 of the public health code, 1978 PA 368, MCL 333.17501 to 333.17556.

(h) "Primary caregiver" or "caregiver" means a person who is at least 21 years old and who has agreed to

assist with a patient's medical use of marihuana and who has not been convicted of any felony within the past 10 years and has never been convicted of a felony involving illegal drugs or a felony that is an assaultive crime as defined in section 9a of chapter X of the code of criminal procedure, 1927 PA 175, MCL 770.9a.

(i) "Qualifying patient" or "patient" means a person who has been diagnosed by a physician as having a debilitating medical condition.

(j) "Registry identification card" means a document issued by the department that identifies a person as a registered qualifying patient or registered primary caregiver.

(k) "Usable marihuana" means the dried leaves and flowers of the marihuana plant, and any mixture or preparation thereof, but does not include the seeds, stalks, and roots of the plant.

(*l*) "Visiting qualifying patient" means a patient who is not a resident of this state or who has been a resident of this state for less than 30 days.

(m) "Written certification" means a document signed by a physician, stating all of the following:

(1) The patient's debilitating medical condition.

(2) The physician has completed a full assessment of the patient's medical history and current medical condition, including a relevant, in-person, medical evaluation.

(3) In the physician's professional opinion, the patient is likely to receive therapeutic or palliative benefit from the medical use of marihuana to treat or alleviate the patient's debilitating medical condition or symptoms associated with the debilitating medical condition.

History: 2008, Initiated Law 1, Eff. Dec. 4, 2008;— Am. 2012, Act 512, Eff. Apr. 1, 2013.

Compiler's note: MCL 333.26430 of Initiated Law 1 of 2008 provides:

10. Severability.

Sec. 10. Any section of this act being held invalid as to any person or circumstances shall not affect the application of any other section of this act that can be given full effect without the invalid section or application.

PUBLIC HEALTH CODE (EXCERPT)
Act 368 of 1978

333.7106 Definitions; I to M.

Sec. 7106. (1) "Immediate precursor" means a substance that the administrator has found to be and by rule designates as being the principal compound commonly used or produced primarily for use and that is an immediate chemical intermediary used or likely to be used in the manufacture of a controlled substance, the control of which is necessary to prevent, curtail, or limit manufacture.

(2) "Industrial hemp" means the plant Cannabis sativa L. and any part of the plant, whether growing or not, with a delta-9-tetrahydrocannibinol concentration of not more than 0.3% on a dry weight basis.

(3) "Manufacture" means the production, preparation, propagation, compounding, conversion, or processing of a controlled substance, directly or indirectly by extraction from substances of natural origin, or independently by means of chemical synthesis, or by a combination of extraction and chemical synthesis. It includes the packaging or repackaging of the substance or labeling or relabeling of its container, except that it does not include either of the following:

(a) The preparation or compounding of a controlled substance by an individual for his or her own use.

(b) The preparation, compounding packaging, or labeling of a controlled substance by either of the following:

(*i*) A practitioner as an incident to the practitioner's administering or dispensing of a controlled substance in the course of his or her professional practice.

(*ii*) A practitioner, or by the practitioner's authorized agent under his or her supervision, for the purpose of, or as an incident to, research, teaching, or chemical analysis, and not for sale.

(4) "Marihuana" means all parts of the plant Cannabis sativa L., growing or not; the seeds of that plant; the resin extracted from any part of the plant; and every compound, manufacture, salt, derivative, mixture, or preparation of the plant or its seeds or resin. Marihuana does not include the mature stalks of the plant, fiber produced from the stalks, oil or cake made from the seeds of the plant, any other compound, manufacture, salt, derivative, mixture, or preparation of the mature stalks, except the resin extracted from those stalks, fiber, oil, or cake, or any sterilized seed of the plant that is incapable of germination. Marihuana does not include industrial hemp grown or cultivated, or both, for research purposes under the industrial hemp research act.

History: 1978, Act 368, Eff. Sept. 30, 1978;— Am. 2014, Act 548, Imd. Eff. Jan. 15, 2015.

Popular name: Act 368

Compiler's note: In subsection (2), the word "delta-9-tetrahydrocannibinol" should evidently read "delta-9-tetrahydrocannabinol."

Medical Marijuana: Review and Analysis of Federal and State Policies

Mark Eddy
Specialist in Social Policy

April 2, 2010

Congressional Research Service
7-5700
www.crs.gov
RL33211

Summary

The issue before Congress is whether to continue the federal prosecution of medical marijuana patients and their providers, in accordance with the federal Controlled Substances Act (CSA), or whether to relax federal marijuana prohibition enough to permit the medicinal use of botanical cannabis products when recommended by a physician, especially where permitted under state law.

Fourteen states, mostly in the West, have enacted laws allowing the use of marijuana for medical purposes, and many thousands of patients are seeking relief from a variety of serious illnesses by smoking marijuana or using other herbal cannabis preparations.

Two bills relating to the therapeutic use of cannabis have been introduced in the 111th Congress. The Medical Marijuana Patient Protection Act (H.R. 2835), which would allow the medical use of marijuana in states that permit its use with a doctor's recommendation, was introduced on June 11, 2009, by Representative Barney Frank. The bill would move marijuana from Schedule I to Schedule II of the CSA and exempt from federal prosecution authorized patients and medical marijuana providers who are acting in accordance with state laws. Also, the Truth in Trials Act (H.R. 3939), a bill that would make it possible for defendants in federal court to reveal to juries that their marijuana activity was medically related and legal under state law, was introduced on October 27, 2009, by Representative Sam Farr.

For the first time since District of Columbia residents approved a medical marijuana ballot initiative in 1998, a rider blocking implementation of the initiative was not attached to the D.C. appropriations act for FY2010 (P.L. 111-117), clearing the way for the creation of a medical marijuana program for seriously ill patients in the nation's capital.

The Obama Administration Department of Justice, in October 2009, announced an end to federal raids by the Drug Enforcement Administration of medical marijuana dispensaries that are operating in "clear and unambiguous compliance with existing state laws." This move fulfills a pledge to end such raids that was made by candidate Obama during the presidential campaign.

Claims and counterclaims about medical marijuana—much debated by journalists and academics, policymakers at all levels of government, and interested citizens—include the following: Marijuana is harmful and has no medical value; marijuana effectively treats the symptoms of certain diseases; smoking is an improper route of drug administration; marijuana should be rescheduled to permit medical use; state medical marijuana laws send the wrong message and lead to increased illicit drug use; the medical marijuana movement undermines the war on drugs; patients should not be arrested for using medical marijuana; the federal government should allow the states to experiment and should not interfere with state medical marijuana programs; medical marijuana laws harm the federal drug approval process; the medical cannabis movement is a cynical ploy to legalize marijuana and other drugs. With strong opinions being expressed on all sides of this complex issue, the debate over medical marijuana does not appear to be approaching resolution.

This report will be updated as legislative activity and other developments occur.

Congressional Research Service
Informing the legislative debate since 1914

Marijuana: Medical and Retail—Selected Legal Issues

Todd Garvey
Legislative Attorney

Charles Doyle
Senior Specialist in American Public Law

David H. Carpenter
Legislative Attorney

April 8, 2015

Congressional Research Service
7-5700
www.crs.gov
R43435

Summary

The federal Controlled Substances Act (CSA) outlaws the possession, cultivation, and distribution of marijuana except for authorized research. More than 20 states have regulatory schemes that allow possession, cultivation, and distribution of marijuana for medicinal purposes. Four have revenue regimes that allow possession, cultivation, and sale generally. The U.S. Constitution's Supremacy Clause preempts any state law that conflicts with federal law. Although there is some division, the majority of state courts have concluded that the federal-state marijuana law conflict does not require preemption of state medical marijuana laws. The legal consequences of a CSA violation, however, remain in place. Nevertheless, current federal criminal enforcement guidelines counsel confining investigations and prosecutions to the most egregious affront to federal interests.

Legal and ethical considerations limit the extent to which an attorney may advise and assist a client intent on participating in his or her state's medical or recreational marijuana system. Bar associations differ on the precise boundaries of those limitations.

State medical marijuana laws grant registered patients, their doctors, and providers immunity from the consequences of state law. The Washington, Colorado, Oregon, and Alaska retail marijuana regimes authorize the commercial exploitation of the marijuana market in small taxable doses.

The present and potential consequences of a CSA violation can be substantial. Cultivation or sale of marijuana on all but the smallest scale invites a five-year mandatory minimum prison term. Revenues and the property used to generate them may merely be awaiting federal collection under federal forfeiture laws. Federal tax laws deny marijuana entrepreneurs the benefits available to other businesses. Banks may afford marijuana merchants financial services only if the bank files a suspicious activity report (SAR) for every marijuana-related transaction that exceed certain monetary thresholds, and only if it conducts a level of due diligence into its customers' activities sufficient to unearth any affront to federal interests.

Marijuana users may not possess a firearm or ammunition. They may not hold federal security clearances. They may not operate commercial trucks, buses, trains, or planes. Federal contractors and private employers may be free to refuse to hire them and to fire them. If fired, they may be ineligible for unemployment compensation. They may be denied federally assisted housing.

At the heart of the federal-state conflict lies a disagreement over dangers and benefits inherent in marijuana use. The CSA authorizes research on controlled substances, including those in Schedule I such as marijuana, that may address those questions. Members have introduced a number of bills in the 114th Congress that speak to the conflict. Additionally, a few marijuana-related provisions were enacted into law late in the 113th Congress.

This report is available in an abridged form, without footnotes or citations to authority, as CRS Report R43437, *Marijuana: Medical and Retail—An Abbreviated View of Selected Legal Issues*, by Todd Garvey and Charles Doyle. Portions of this report have been borrowed from CRS Report R43034, *State Legalization of Recreational Marijuana: Selected Legal Issues*, by Todd Garvey and Brian T. Yeh.

Science News *from research organizations*

University Of Toronto Study Shows Marijuana Not A Factor In Driving Accidents

Date: March 29, 1999

Source: University Of Toronto

Summary: The safety hazards of smoking marijuana and driving are overrated, says University of Toronto researcher Alison Smiley, whose study of impairment and traffic accident reports from several countries shows that marijuana taken alone in moderate amounts does not significantly increase a driver's risk of causing an accident.

FULL STORY

The safety hazards of smoking marijuana and driving are overrated, says University of Toronto researcher Alison Smiley.

Recent research into impairment and traffic accident reports from several countries shows that marijuana taken alone in moderate amounts does not significantly increase a driver's risk of causing an accident -- unlike alcohol, says Smiley, an adjunct professor in the department of mechanical and industrial engineering. While smoking marijuana does impair driving ability, it does not share alcohol's effect on judgment. Drivers on marijuana remain aware of their impairment, prompting them to slow down and drive more cautiously to compensate, she says.

"Both substances impair performance," Smiley says. "However, the more cautious behaviour of subjects who received marijuana decreases the drug's impact on performance. Their behaviour is more appropriate to their impairment, whereas subjects who received alcohol tend to drive in a more risky manner."

Smiley, who has studied transportation safety for over 25 years, drew her results from a "metanalysis" of existing research into the effects of marijuana on driving ability, combined with traffic accident statistics in the United States and Australia. Previous studies showing stronger effects often combined

Related Stories

Research on Marijuana's Negative Health Effects Summarized in Report

Marijuana Use Involved in More Fatal Accidents Since Commercialization of Medical Marijuana

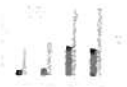
Underage College Men Discount Dangers of Driving After Marijuana Use

Teens Who Use Alcohol, Marijuana Together Are at Higher Risk for Unsafe Driving

Marijuana Use May Double the Risk of Accidents for Drivers, Study Finds

Strange & Offbeat

HEALTH & MEDICINE



Polygamy Increases Risk of Heart Disease by More Than 4-Fold

Bacteria in Medical Implants on Purpose? Opening the Way to Living Implants

Breast Milk Sharing Among Friends, Relatives Likely Increasing, but Still Risky

Brain Balances Perception and Action When Caught in an Illusion

MIND & BRAIN

Switching on One-Shot Learning in the Brain

NFL Drafts: NFL Players With an Arrest Record but No Charges Did Well

"fairly hefty doses" by researchers with driving immediately after consumption, likely exaggerating the drug's effects, she believes.

While Smiley does not advocate legalizing the drug, she says her results should be considered by those debating mandatory drug tests for users of transportation equipment such as truck or train drivers, or the decriminalization of marijuana for medical use. "There's an assumption that because marijuana is illegal, it must increase the risk of an accident. We should try to just stick to the facts."

Smiley presented her findings at a symposium of the American Academy of Forensic Sciences in Florida in February. Her paper was also published in Health Effects of Cannabis, a publication of Toronto's Centre for Addiction and Mental Health, in March.

CONTACT:Bruce RolstonU of T Public Affairs(416) 978-6974bruce.rolston@utoronto.ca

Story Source:

The above story is based on materials provided by **University Of Toronto**. *Note: Materials may be edited for content and length.*

Cite This Page:

MLA APA Chicago

University Of Toronto. "University Of Toronto Study Shows Marijuana Not A Factor In Driving Accidents." ScienceDaily. ScienceDaily, 29 March 1999. <www.sciencedaily.com/releases/1999/03/990325110700.htm>.

Share This Page:

RELATED TOPICS

Health & Medicine

- Controlled Substances
- Teen Health
- Pharmacology

Trends & Issues

RELATED TERMS

- Chernobyl disaster

Framing Time in Days Instead of Years Could Spur Action Toward Goals

Text Messaging Reduces Pain Medicine Requirements During Surgery

LIVING & WELL

Psychology of the Appeal of Being Anti-GMO

Genes Make Some People Mosquito Targets, Twins Pilot Study Shows

Ten More Years of Real Money?

Social Shaming and the Search for Validation

Other News *from NewsDaily*

SCIENCE

Motion capture on a whole new level

Space station docking with supply ship delayed by technical hitch

SpaceX rocket blasts off with 1st satellite for Turkmenistan

Zebrafish 'inner ear' development wins science video prize

'Jigsaw puzzle' dinosaur Chilesaurus boasted weird mix of traits

HEALTH

AstraZeneca heart drug in regulatory fast lane for wider use

U.S. officials predict a return of avian flu in the fall

Strong Merck cancer drug sales upstage rival Bristol-Myers

Florida governor sues Obama administration over healthcare funding

Some health food stores may sell 'adult' supplements to kids

Am J Addict. Author manuscript; available in PMC 2010 May 1.
Published in final edited form as:
Am J Addict. 2009; 18(3): 185–193.
doi: 10.1080/10550490902786934

PMCID: PMC2722956
NIHMSID: NIHMS115730

THE EFFECT OF CANNABIS COMPARED WITH ALCOHOL ON DRIVING

R. Andrew Sewell, MD,* James Poling, PhD, and Mehmet Sofuoglu, MD, PhD

R. Andrew Sewell, VA Connecticut Healthcare/Yale University School of Medicine, 950 Campbell Ave, Building 36, West Haven, CT 06516, Tel: (203)937-4835, Fax: (203)937-3478, Email: asewell71@gmail.com;
Contributor Information.
*Corresponding author.

Abstract

Go to:

The prevalence of both alcohol and cannabis use and the high morbidity associated with motor vehicle crashes has lead to a plethora of research on the link between the two. Drunk drivers are involved in 25% of motor vehicle fatalities, and many accidents involve drivers who test positive for cannabis. Cannabis and alcohol acutely impair several driving-related skills in a dose-related fashion, but the effects of cannabis vary more between individuals than they do with alcohol because of tolerance, differences in smoking technique, and different absorptions of Δ^9-tetrahydrocannabinol (THC), the active ingredient in marijuana. Detrimental effects of cannabis use vary in a dose-related fashion, and are more pronounced with highly automatic driving functions than with more complex tasks that require conscious control, whereas with alcohol produces an opposite pattern of impairment. Because of both this and an increased awareness that they are impaired, marijuana smokers tend to compensate effectively while driving by utilizing a variety of behavioral strategies. Combining marijuana with alcohol eliminates the ability to use such strategies effectively, however, and results in impairment even at doses which would be insignificant were they of either drug alone. Epidemiological studies have been inconclusive regarding whether cannabis use causes an increased risk of accidents; in contrast, unanimity exists that alcohol use increases crash risk. Furthermore, the risk from driving under the influence of both alcohol and cannabis is greater than the risk of driving under the influence of either alone. Future research should focus on resolving contradictions posed by previous studies, and patients who smoke cannabis should be counseled to wait several hours before driving, and avoid combining the two drugs.

Keywords: marijuana, alcohol, driving, review

1. Introduction

Go to:

Accidents are the fifth leading cause of death in the US; nearly half are motor vehicle accidents, which according to the Fatality Analysis Reporting System (FARS) killed 38,588 people in 2006 alone.[1] Motor vehicle accidents are the nation's leading cause of death in those under 30.[2] The contribution of drugs of abuse to this accident rate has attracted increasing attention in recent years because of the dramatic increase in drug use. In 2002, the National Survey on Drug Use and Health (NSDUH) estimated that 22 million Americans—9.4% of the population—have a substance use or dependence problem. As marijuana is the most commonly used drug of abuse, having been tried by 40% of the population,[3] and is also smoked most commonly in the age group that also

has the most road traffic accidents, the contribution of marijuana smoking to road traffic accidents is of great concern to both governments and clinicians responsible for counseling patients with substance abuse problems. Moreover, given the paucity of data supporting marijuana's acute toxicity, the most serious possible consequence of acute cannabis use is a road traffic accident from driving while intoxicated.[4] The very high cost of crashes, both human and financial, underlines the importance of understanding the extent to which marijuana use contributes to such accidents. The purpose of this paper is to review the scientific evidence on the effects on driving while intoxicated with marijuana and contrast this with the effects of alcohol intoxication.

2. Epidemiology of marijuana smoking and road traffic accidents

Go to:

The rising prevalence of cannabis use, its increased availability and potency,[5] lower prices, widespread social tolerance, and earlier age of onset of use have combined to increase the number of users and hence the number of people subject to cannabis use disorders.[6] Peak initiation is at age 18, and ten years later, 8% of users are marijuana-dependent.[7] Most cannabis use is intermittent and time-limited, however; users generally stop in their mid-to-late 20s, and only a small minority continue in daily use over a period of years.[8]

Young people also account for a disproportionate number of road traffic accidents. According to the National Center for Statistics and Analysis, the fatality rate for teenagers is four times that of drivers age 25 to 69, and drivers under age 25 account for a quarter of all traffic fatalities.[9] Risk factors for having a fatal traffic accident include being a young man, having psychological characteristics such as thrill-seeking and overconfidence, driving at excessive speed, driving late at night, failing to wear a seatbelt, and lacking familiarity with the vehicle.[10] The risk factors for adolescent marijuana use are somewhat overlapping—delinquency (vandalism, shoplifting, joyriding etc.), poor school performance, and substance use by self and peers.[11]

The National Highway Transportation Safety Administration (NHTSA) reported that in 25% of all motor vehicle crash fatalities, the driver had a blood alcohol concentration (BAC) of 0.01 g/dL (one eighth the legal limit) or greater, and in 21-year-old drivers, that figure rose to 39%.[12] Drivers with a previous DWI ("Driving While Impaired") conviction were responsible for 7.2% of all crashes involving alcohol.

In comparison, the percentage of road traffic accidents in which one driver tested positive for marijuana ranges from 6% to 32%.[13, 14] In one study, 9.7% of cannabis smokers reported having driven under the influence in the previous year; those who did drove while intoxicated an average of 8.1 times during the year.[15] Among those who seek treatment for cannabis problems, more than 50% report having driven while "stoned" at least once in the previous year.[16, 17]

3. Studies relevant to marijuana and smoking

Go to:

Three types of studies are generally performed to help assess the risk that smoking marijuana may increase the probability of having a fatal traffic accident. The first are *cognitive studies* that measure the effects of smoking marijuana on cognitive processes that are considered to be integral to safe driving. The second are *experimental studies* on the collision risk of people under the influence of marijuana. The third are descriptive and analytic *epidemiological studies* on the relationship between cannabis use and accidents, usually performed through drug testing of injured drivers.

3.1 Cognitive studies

Attentiveness, vigilance, perception of time and speed, and use of acquired knowledge are all affected by marijuana;[18–21] in fact, a meta-analysis of 60 studies concluded that marijuana causes impairment in every performance area that can reasonably be connected with safe driving of a vehicle, such as tracking, motor coordination, visual functions, and particularly complex tasks that require divided attention,[22] although studies on marijuana's effects on reaction time have been contradictory.[23] Similar conclusions have been reached by other reviewers.[2] Worse still, marijuana and alcohol, when used together, have additive or even multiplicative effects on

impairment.[24] Consequently, on the basis of cognitive studies, it seems reasonable to propose that smoking marijuana may increase the risk of having a fatal traffic accident.

Alcohol at 0.75 g/kg (slightly less than four standard drinks) causes high levels of impairment in psychomotor performance and medium-to-high levels of impairment in such tasks as critical flicker fusion and short-term memory.[25] Alcohol impairs pursuit tracking, divided attention, signal detection, hazard perception,[26–28] reaction time, attention, concentration, and hand-eye coordination.[29, 30]

Alcohol also reduces the perceived negative consequences of risk-taking,[31] which can increase willingness to take risks after drinking,[32] the amount of risk-taking behavior while driving, even at low alcohol doses,[33] and the incidence of road traffic accidents while driving drunk.[34, 35] However, there is considerable variability in the effects that alcohol can have on people—the same dose may have different effects not only on different individuals, but also in the same individual on different occasions, because of other factors such as gender, body mass index, age, drinking habits, time of day, stomach contents, genetics, stage of the menstrual cycle, and environmental factors.[36]

3.2 Experimental research (driving and simulator studies)

Experimental research measures the potential risk of an accident using a driving simulator or driving course.

3.2.1 Studies that do not show impairment Surprisingly, given the alarming results of cognitive studies, most marijuana-intoxicated drivers show only modest impairments on actual road tests.[37, 38] Experienced smokers who drive on a set course show almost no *functional* impairment under the influence of marijuana, except when it is combined with alcohol.[39]

Many investigators have suggested that the reason why marijuana does not result in an increased crash rate in laboratory tests despite demonstrable neurophysiologic impairments is that, unlike drivers under the influence of alcohol, who tend to underestimate their degree of impairment, marijuana users tend to *overestimate* their impairment, and consequently employ compensatory strategies. Cannabis users perceive their driving under the influence as impaired and more cautious,[40] and given a dose of 7 mg THC (about a third of a joint), drivers rated themselves as impaired even though their driving performance was not; in contrast, at a BAC 0.04% (slightly less than two "standard drinks" of a can of beer or small 5 oz. glass of wine; half the legal limit in most US states), driving performance was impaired even though drivers rated themselves as unimpaired.[41] Binge drinkers are particularly likely to rate themselves as unimpaired, possibly because they tend to become less sedated by high doses of alcohol.[42]

This awareness of impairment has behavioral consequences. Several reviews of driving and simulator studies have concluded that marijuana use by drivers is likely to result in decreased speed and fewer attempts to overtake, as well as increased "following distance". The opposite is true of alcohol.[43] One review of eight driving simulator studies and seven on-road studies[44] found that cannabis use was associated with either poor lane control[41, 45–48] or slower driving that successfully maintained lane control.[49–51] In seven of ten studies cited, cannabis use was associated with a decrease in driving speed despite explicit instructions to maintain a particular speed, whereas under the influence of alcohol, subjects consistently drove faster. Two simulator studies showed that the tendency to overtake was decreased with cannabis use but increased with alcohol.[52, 53] One simulator study and two on-road studies examining car-following behavior concluded that cannabis smokers tend to increase the distance between themselves and the car in front of them.[41, 45] Other studies have found no adverse effects of marijuana use on sign detection,[49] a sudden lane-changing task,[43] or the detection of and response to hazardous events.[48]

3.2.2 Studies that show impairment Not all deficits can be compensated for through the use of behavioral strategies, however. Both alcohol and marijuana use increase reaction time and the number of incorrect responses to emergencies.[43] Drivers under the influence of marijuana were not able to compensate for standard deviation of lateral position (SDLP, a measure of staying within lane), which increased with increasing doses of THC. This is a

measure that is not subject to conscious compensatory mechanisms in the way that other aspects of driving are. Other studies have found poorer monitoring of the speedometer under the influence of marijuana,[54] increased decision time when passing,[52] increased time needed to brake when a light suddenly changes,[55] and increased time to respond to a changing light[45, 56] or sudden sound.[57] Drivers also crashed more frequently into a sudden obstacle on a high dose of marijuana, although this did not happen at a low dose.[45]

Meta-analyses of over 120 studies have found that in general, the higher the estimated concentration of THC in blood, the greater the driving impairment, but that more frequent users of marijuana show less impairment than infrequent users at the same dose, either because of physiological tolerance or learned compensatory behavior. Maximal impairment is found 20 to 40 minutes after smoking, but the impairment has vanished 2.5 hours later, at least in those who smoke 18 mg THC or less (the dose often used experimentally to duplicate a single joint).[58, 59]

With increasing doses of alcohol, however, there is general dose-dependent lowering of both sustained attention and overall attentional capacity, with consequently more concentration paid to the main component of a complex skill (steering, for example), and less and less attention paid to secondary tasks (such as speed or driving skill). Functional imaging on the effects of increasing doses of alcohol up to a BAC of 0.08% in simulated driving has demonstrated that orbitofrontal areas (subsuming judgment) and motor areas are affected first, then cerebellar areas controlling coordination show functional deterioration, and finally, at high doses, global cognitive networks and simulated driving performance are impaired.[60]

Interestingly, three reports indicate that chronic marijuana smokers are less susceptible to impairment from alcohol on some measures compared with nonsmokers or infrequent smokers. As far back as 1970, Reese Jones noticed that alcohol's effects were diminished in heavy cannabis smokers.[61] A subsequent study showed that regular cannabis smokers demonstrate less of a decrement in peripheral signal detection under the influence of alcohol than do infrequent users,[62] and a later study still found that regular cannabis users given alcohol alone showed less of a decrement in tracking accuracy and dizziness ratings than infrequent users given the same alcohol dose.[63] The reason for this is unclear, but is hypothesized to result from either pharmacological or behavioral cross-tolerance between marijuana and alcohol.

3.2.3 Summary of experimental studies It appears that cannabis use may impair some driving skills (automatic functions such as tracking) at smoked doses as low as 6.25 mg (a third of a joint), but different skills (complex functions that require conscious control) are not impaired until higher doses, and cannabis users tend to compensate effectively for their deficits by driving more carefully. Unexpected events are still difficult to handle under the influence of marijuana, however, and the combination of low-dose alcohol and low-dose cannabis causes much more impairment than either drug used alone.[48, 64, 65] Alcohol appears to impair tasks requiring cognitive control more than it does automatic functions, whereas marijuana at a comparable dose impairs automatic functions more than those requiring cognitive control. Together, the effects on impairment are additive and may even be synergistic. Chronic marijuana smokers are less impaired by both alcohol and marijuana than would be expected, however.

3.3 Epidemiologicalstudies

One weakness of driving studies is that subjects are aware of being observed and assessed, so such studies are generally a better measure of what drivers are capable of doing rather than what they actually do. Epidemiological studies attempt to assess the *actual* risk that a driver may cause an accident under the influence of a drug, relative to that of a sober person driving under similar conditions. The relative risk is expressed in the form of an "odds ratio" (OR), which is the multiplier for the increased accident risk from driving under the influence of marijuana. Two approaches are taken. The first is *culpability studies,* which classify drivers who have crashed according to their degree of responsibility for the crash, then compare drug use in each category. If there is greater use of the drug in those culpable for crashes, then the drug is judged to be responsible for a greater crash risk. The second is *case control studies*. We will discuss both in turn.

3.3.1 Culpability studies

3.3.1.1 Studies that do not show culpability Some reviewers have concluded that there is no evidence that cannabis alone increases the risk of culpability for crashes, and may actually reduce risk.[66] Drummer's review of blood samples of traffic fatalities in Australia found that drivers testing positive for marijuana were actually *less* likely to have been judged responsible for the accident.[67] Several other studies have found no increase in crash risk with cannabis.[68–70] Williams' California study of 440 male traffic accident deaths found that while alcohol use was related to crash culpability, cannabis use was not.[71] Terhune's study of 1882 motor vehicle deaths calculated an OR of 0.7 for cannabis use, 7.4 for alcohol use, and 8.4 for cannabis and alcohol use combined.[68] Lowenstein and Koziol-McLain's study of 414 injured drivers admitted to a Colorado E/R found an OR of 1.1, indicating that marijuana use was not associated with increased crash responsibility.[72] Drummer's later and more extensive ten-year study of 3400 traffic fatalities in three Australian states found that drivers with blood THC levels less than 5 ng/mL, and those with only carboxy-THC present (THC-COOH, a metabolite that is excreted in the urine for weeks and is thus more likely to indicate past use than current use), had an OR of 1.0, but those with serum levels greater than 5 ng/mL had an OR of 6.6, the same as that for a BAC of 0.15%. In all 30 cases in this study in which one driver had a serum level of THC greater than 10 ng/mL, that driver was judged to have been responsible for the accident. When marijuana was combined with alcohol, the risk was higher still.[73] A later reanalysis of the same data that adjusted for the age and sex of the fatalities found that OR of crashing for cannabis use alone dropped to 0.6 (not significantly different from 1.0), versus 7.6 for alcohol.[66] Laumon's study of 10,748 French motor vehicle fatalities found that although rates of alcohol and cannabis intoxication were similar (nearly 3%), ten times as many crashes were associated with alcohol as with cannabis; however, investigators noted a dose-dependent effect on OR with increasing THC serum levels, confirming Drummer's observation by calculating an OR of 4.72 for THC levels greater than 5 ng/mL.[74] Longo's large, well-known study of hospitalized injured drivers in South Australia showed few adverse effects of cannabis on crash risk, although there was a slightly increased risk of crashing with higher THC concentrations and a slightly lower risk with lower concentrations.[75]

What 5 ng/mL means in terms of actual impairment is hard to calculate, as THC levels in the blood peak quickly following inhalation then decrease rapidly according to complex pharmacokinetics, making it almost impossible to extrapolate backwards from the concentration of THC at the time of the blood test to the concentration at the time of the traffic accident. Some insight can be gained from Jones' study of 1276 Swedish motorists arrested for DUI with blood tests positive for THC alone, which revealed an average THC blood level of 3.6 ng/mL at the time of testing.[76] A similar Swiss study of 440 DUI suspects who also were positive for only THC found average blood concentrations of 5.0 ng/mL at the time of testing, indicating that a residual level of 5 ng/mL does appear to correlate with observable driving impairment earlier.[77] The Swedish study also found that, of the 291 DUI arrestees who were positive for both THC and alcohol, the average THC blood level was only 2.3 ng/mL, again suggesting that lower levels of THC, when combined with alcohol, are sufficient to cause obvious impairment.[76]

Methodological problems often can make culpability studies hard to interpret, however. Since no study has ever shown an increased risk of road accidents among frequent marijuana smokers who are not intoxicated at the time that they drive, a positive urine test that measures levels of the long-lasting metabolite carboxy-THC but not the active ingredient THC is insufficient to classify a driver as intoxicated, as such a measure will include in the marijuana group unimpaired people who have smoked only in the past and thus artificially depress the OR.[78] The Colorado study that found that marijuana use was not associated with increased crash responsibility used urine toxicology to assess drug use, so likely suffered from this limitation.[72] Sampling delays in excess of an hour can cause an underestimation of THC concentration in the blood of injured drivers who test positive for marijuana, possibly explaining Longo and others' failure to find adverse effects.

Alcohol levels, which have linear pharmacokinetics, are easier to back-calculate to the time of the accident, and are consistently linked with increased culpability in crashes.[71, 75] Moreover, whereas CNS levels of alcohol, which moves easily throughout the body with little difference in concentration between compartments, can be

approximated with a good degree of accuracy through measuring blood or breath levels, the same is not true of THC, which is highly lipophilic and concentrates preferentially in adipose tissue. Consequently, experimental studies have shown that functional impairment (which reaches a maximum an hour after smoking) lags behind THC blood level (which peaks within minutes and decreases rapidly thereafter).[79] (Figure 1) This makes it much harder to generate blood level versus impairment curves for marijuana than it is for alcohol.

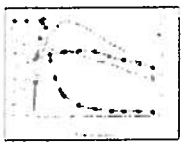


Figure 1

Subjective effects of alcohol and cannabis in relation to serum levels of ethanol lag subjective effects because of rapid acute tolerance. Subjective effects of THC lag serum levels because of slower redistribution into CNS compartment.(Adapted from Portans ...

3.3.1.2 Studies that show culpability Several studies have found that cannabis users are more likely to be responsible for crashes (OR 1.7).[80–82] Crouch found that marijuana use contributed to the demise of 168 fatally-injured truckers in all cases in which the serum concentration of THC exceeded 1 ng/mL.[83] Terhune's study of 497 road traffic accidents found that cannabis users had a responsibility rate of 76% versus 42.5% for the control group.[84] A later, larger study by the same author on 1882 drivers killed in seven US states found no difference between responsibility rates, however,[68] and it is unclear why the conclusions of the two studies differed.

Unfortunately, many positive studies fail to take into consideration interactions with other drugs,[80–82] and since alcohol and cannabis in combination cause more impairment than either drug alone, failure to control for concurrent alcohol use represents a significant limitation. Lack of blinding can also be a problem, as knowledge by the raters of drug use influences assignment of culpability. This was likely a confound in Crouch's study.[83]

3.3.1.3 Summary of culpability studies Although the results of culpability studies have therefore been somewhat contradictory, all find that the combination of alcohol and cannabis has worse consequences than use of cannabis alone.[68, 71, 73, 85] In general, culpability studies suffer from two main confounds. The first is delay to sampling, which classifies some THC users who were impaired at the time of the accident into the non-use group, and the second is use of the metabolite carboxy-THC to identify marijuana-users, which can mistakenly classify some non-impaired drivers in the impaired group.

3.3.2 Case control studies In contrast with culpability studies, *case control studies* compare the prevalence of marijuana use among drivers injured or killed in traffic accidents with a control group of other drivers. The validity of these studies depends upon careful selection of an appropriate control group for comparison.

3.3.2.1 Studies that found no increased risk One prospective observational case-control study by Movig in the Netherlands found an OR of 1.2—no significant association—between marijuana use and crash risk, even when not controlling for use of other drugs.[86] In fact, a preliminary analysis by the same group that had controlled for other drugs had initially generated an OR of 0.3.[87] Jones' more recent study also found no increase in the past-year accident rate between cannabis smokers and controls.[88]

3.3.2.2 Studies that show increased risk In contrast, some case-control studies have indicated increased risk. Gerberich, in a large retrospective study of 64,657 health plan members in Northern California, found an OR of 2.3 for motor vehicle injuries among male cannabis users versus nonusers.[89] Mura's French study of injured drivers in the emergency room calculated an OR of 2.5 for marijuana users versus sober controls, which rose to 4.6 when alcohol was combined with marijuana.[90] Dussault and Breault's large prospective study comparing THC in the blood or carboxy-THC in the urine of traffic fatalities with similar tests of drivers in a roadside survey calculated an OR of 2.2 for marijuana use leading to fatal injury.[91, 92] Another study of 30,896 traffic fatilities found that of the 1,647 in which cannabis was present, cannabis use was associated with an OR of 1.29 for a potentially unsafe driving behavior preceding the crash,[93] although, interestingly, there was no difference in rates of failure to stay within lane between cannabis users and non-users, contradicting the findings of several

laboratory studies.[95, 94]

3.3.3 Summary of epidemiological studies The validity of case-control studies rests entirely on careful matching of cases with controls, which is hard to do. In Movig's study, which assessed marijuana use through both urine and blood testing, urine testing (which measures carboxy-THC) was performed on twice as many controls (85%) as accident victims (39%), likely overestimating the prevalence of marijuana use in the control group and artificially depressing the OR. Dussault and Breault's study also only measured carboxy-THC, so the calculated OR was really for the risk of accidents given marijuana use at all rather than for marijuana use while driving. In addition, 15.4% of their roadside survey control group refused testing, and since this was the subset of the group that was more than likely to have been using illicit drugs, the refusals probably depressed the incidence of marijuana use in the control group and artificially increased the OR. The control group in Mura's study was comprised of non-trauma patients at the hospital, rather than drivers who had not crashed, making the odds ratio an incorrect calculation. In addition, non-trauma hospital patients are not representative of the population and arguably may have had a lower rate of marijuana smoking, again distorting the OR.

Because of these difficulties, epidemiological studies have also shown inconsistent effects, some finding decreased or no risk from driving while smoking marijuana, and others increased risk. Most studies are fraught with methodological problems that could lead to underreporting of drug use or misclassification of experimental subjects into or out of the marijuana-using category, confounding results.

In contrast, epidemiological studies on the relationship between alcohol consumption and accident have been clear-cut and consistent, demonstrating that the risk of a motor vehicle accident increases significantly with BAC > 0.05%.[95]

4. Summary of effects of marijuana on driving performance

Go to:

Although cognitive studies suggest that cannabis use may lead to unsafe driving, experimental studies have suggested that it can have the opposite effect. Epidemiological studies have themselves been inconsistent, and thus have not resolved the question. One possibility is that people who smoke marijuana share qualities—being young, male, and risk-taking—that would increase their risk of road traffic accidents even in the absence of marijuana use. It has been suggested that there is a single factor that underlies adolescent "problem behaviors" such as illicit drug use, precocious sexual intercourse, and problem drinking.[96] Two epidemiological studies in New Zealand that attempted to address this hypothesis found that the significant relationship that existed between self-reported cannabis use and self-reported accidents (OR 1.6 and 3.9, respectively) disappeared after risky driver behaviors and unsafe driver attitudes were controlled for.[97, 98] A follow-up study found that the crash risk for driving under the influence of cannabis more than 20 times in one year (OR 2.25) was halved and reduced to marginal significance when distance driven and self-reported risky driving behaviors were controlled for.[99] A third Canadian study that compared crash rates in cannabis users found an even higher adjusted OR of 2.61 for crashing over the course of the year in those who drove while "stoned" versus marijuana smokers who did not, suggesting that the decision to drive while intoxicated may predict poor judgment and unsafe driving habits even in the absence of marijuana use.[100]

In summary, laboratory tests and driving studies show that cannabis may acutely impair several driving-related skills in a dose-related fashion, but that the effects between individuals vary more than they do with alcohol because of tolerance, differences in smoking technique, and different absorptions of THC. Driving and simulator studies show that detrimental effects vary in a dose-related fashion, and are more pronounced with highly automatic driving functions, but more complex tasks that require conscious control are less affected, which is the opposite pattern from that seen with alcohol. Because of both this and an increased awareness that they are impaired, marijuana smokers tend to compensate effectively for their impairment by utilizing a variety of behavioral strategies such as driving more slowly, passing less, and leaving more space between themselves and cars in front of them. Combining marijuana with alcohol eliminates the ability to use such strategies effectively,

however, and results in impairment even at doses that would be insignificant were they of either drug alone. Case-control studies are inconsistent, but suggest that while low concentrations of THC do not increase the rate of accidents, and may even decrease them, serum concentrations of THC higher than 5 ng/mL are associated with an increased risk of accidents (Figure 2). Overall, though, case-control and culpability studies have been inconclusive, a determination reached by several other recent reviewers.[101, 102] Similar disagreement has never existed in the literature on alcohol use and crash risk.[103]

Figure 2

Correlation between THC concentration in whole blood and accident risk (from Grotenhermen *et al.* (2007)[78] based on data from Drummer *et al.*[73]).

Future research should concentrate on resolving contradictions posed by previous studies by more tightly controlling for methodological problems. Experimental studies could focus on measuring blood levels consistently or developing more accurate methods of measuring THC levels in the CNS, as well as examining residual effects that persist for more than one hour after smoking. This would permit construction of a better dose-impairment curve for THC. It would also be interesting to know whether the improved performance of experienced users is because of physiological tolerance or because of behavioral strategies that can be taught to infrequent users. Epidemiological studies should use serum THC levels rather than urinary metabolites, develop techniques to compensate for the time delay between the accident and the blood test, and use non-fatally injured drivers for a control group. Comparisons between the public health risks of driving while intoxicated with marijuana and the driving risks associated with sleep deprivation, old age, distractions, and prescription medications should also be examined in order to guide more prudently the allocation of scarce public health resources.

In the meantime, patients who smoke marijuana should be counseled to have a designated driver if possible, to wait at least three hours after smoking before driving if not, that marijuana is particularly likely to impair monotonous or prolonged driving, and that mixing marijuana with alcohol will produce much more impairment than either drug used alone. According to the NHTSA, 72% of all alcohol–related fatalities are in unrestrained drivers (in comparison with only 45% in non-alcohol-related motor vehicle fatalities),[12] and it is reasonable to suspect that similar lack of attention to use of seatbelts is true of cannabis-intoxicated drivers as well. Although not all marijuana smokers are impulsive risk-takers, impulsive risk-takers are likely to smoke marijuana, drive recklessly, and also smoke marijuana before driving. Identification of such traits in a marijuana-using patient should prompt additional counseling on using a seatbelt and other "harm-minimization" interventions.

Acknowledgments

Go to:

This research was supported by the Veterans Administration Mental Illness Research, Education and Clinical Center (MIRECC) and the National Institute on Drug Abuse grant K02-DA-021304 (MS).

Contributor Information

Go to:

R. Andrew Sewell, VA Connecticut Healthcare/Yale University School of Medicine, 950 Campbell Ave, Building 36, West Haven, CT 06516, Tel: (203)937-4835, Fax: (203)937-3478, Email: asewell71@gmail.com.

James Poling, VA Connecticut Healthcare/Yale University School of Medicine.

Mehmet Sofuoglu, VA Connecticut Healthcare/Yale University School of Medicine.

References

Go to:

1. National Highway Traffic Safety Administration. Fatality Analysis Reporting System (FARS) National Center for Statistics and Analysis. 2008

2. Centers for Disease Control and Prevention. National Center for Injury Prevention and Control, Centers for Disease Control and Prevention. 2008. Web-Based Injury Statistics Query and Reporting System (WISQUARS)

3. Office of Applied Studies. Results from the 2005 National Survey on Drug Use and Health: National Findings. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2006.

4. Hall W, Solowij N, Lemon J. The health and psychological consequences of cannabis use. Canberra: Australian Government Publishing Service; 1994.

5. ElSohly M, Ross S, Mehmedic Z, Arafat R, Yi B, Banahan Br. Potency trends of delta-9-THC and other cannabinoids in confiscated marijuana from 1980–1997. Journal of Forensic Sciences. 2000;45(1):24–30. [PubMed]

6. Dennis M, Babor TF, Roebuck MC, Donaldson J. Changing the focus: the case for recognizing and treating cannabis use disorders. Addiction. 2002 Dec;97 (Suppl 1):4–15. [PubMed]

7. Wagner FA, Anthony JC. From first drug use to drug dependence; developmental periods of risk for dependence upon marijuana, cocaine, and alcohol. Neuropsychopharmacology. 2002 Apr;26(4):479–488. [PubMed]

8. Bachman DS. Smoking cessation via telephone counseling & tools for helping your patients quit smoking once and for all. J Ark Med Soc. 1997 Sep;94(4):147–148. [PubMed]

9. National Highway Traffic Safety Administration. Traffic Safety Facts 2000: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System. Washington, DC: National Center for Statistics and Analysis, U.S. Department of Transportation; 2001.

10. World Health Organization. World Report on Road Traffic Injury Prevention. Geneva, Switzerland: World Health Organization; 2004.

11. van den Bree MB, Pickworth WB. Risk factors predicting changes in marijuana involvement in teenagers. Arch Gen Psychiatry. 2005 Mar;62(3):311–319. [PubMed]

12. Subramanian R. Alcohol Involvement in Fatal Motor Vehicle Traffic Crashes, 2003. Springfield, VA: National Highway Traffic Safety Administration (NHTSA); 2005.

13. McLean S, Parsons RS, Chesterman RB, Dineen R, Johnson MG, Davies NW. Drugs, alcohol and road accidents in Tasmania. Med J Aust. 1987 Jul 6;147(1):6–11. [PubMed]

14. Soderstrom CA, Dischinger PC, Kerns TJ, Trifillis AL. Marijuana and other drug use among automobile and motorcycle drivers treated at a trauma center. Accid Anal Prev. 1995 Feb;27(1):131–135. [PubMed]

15. Alvarez FJ, Fierro I, Del Rio MC. Cannabis and driving: results from a general population survey. Forensic Sci Int. 2007 Aug 6;170(2–3):111–116. [PubMed]

16. Albery IP, Strang J, Gossop M, Griffiths P. Illicit drugs and driving: prevalence, beliefs and accident involvement among a cohort of current out-of-treatment drug users. Drug Alcohol Depend. 2000 Feb 1;58(1–2):197–204. [PubMed]

17. Macdonald S, DeSouza A, Mann R, Chipman M. Driving behavior of alcohol, cannabis, and cocaine abuse treatment clients and population controls. Am J Drug Alcohol Abuse. 2004 May;30(2):429–444. [PubMed]

18. Moskowitz H. Marihuana and driving. Accid Anal Prev. 1985 Aug;17(4):323–345. [PubMed]

19. Hall W. The health and psychological consequences of cannabis use. Canberra: Australian Government Publication Service; 1994.

20. Kurzthaler I, Hummer M, Miller C, et al. Effect of cannabis use on cognitive functions and driving ability. J

Clin Psychiatry. 1999 Jun;60(6):395–399. [PubMed]

21. Liguori A, Gatto CP, Robinson JH. Effects of marijuana on equilibrium, psychomotor performance, and simulated driving. Behav Pharmacol. 1998 Nov;9(7):599–609. [PubMed]

22. Berghaus G, Guo B. Medicines and driver fitness--findings from a meta-analysis of experimental studies as basic information to patients, physicians and experts. In: Kloeden C, McLean A, editors. Alcohol, Drugs, and Traffic Safety--T95: Proceedings of the 13th International Conference on Alcohol, Drugs and Traffics Safety; 1995; Adelaide, Australia. 1995. pp. 295–300.

23. Foltin R, Evans S. Performance Effects of Drugs of Abuse: A Methodological Survey. Human Psychopharmacology. 1993;8:9–19.

24. Chesher G. The Effects of Alcohol and Marijuana in Combination: A Review. Alcohol, Drugs and Driving. 1986;2:105–119.

25. Hindmarch I, Kerr JS, Sherwood N. The effects of alcohol and other drugs on psychomotor performance and cognitive function. Alcohol Alcohol. 1991;26(1):71–79. [PubMed]

26. Gengo FM, Gabos C, Straley C, Manning C. The pharmacodynamics of ethanol: effects on performance and judgment. J Clin Pharmacol. 1990 Aug;30(8):748–754. [PubMed]

27. Irving A, Jones W. Methods for testing impairment of driving due to drugs. Eur J Clin Pharmacol. 1992;43(1):61–66. [PubMed]

28. West R, Wilding J, French D, Kemp R, Irving A. Effect of low and moderate doses of alcohol on driving hazard perception latency and driving speed. Addiction. 1993 Apr;88(4):527–532. [PubMed]

29. Couper F, Logan B. Drugs and Human Performance Fact Sheets. Washington, DC: National Highway Traffic Safety Administration; 2004.

30. Gieringer DH. Marijuana, driving, and accident safety. J Psychoactive Drugs. 1988 Jan-Mar;20(1):93–101. [PubMed]

31. Fromme K, Katz E, D'Amico E. Effects of alcohol intoxication on the perceived consequences of risk taking. Exp Clin Psychopharmacol. 1997 Feb;5(1):14–23. [PubMed]

32. MacDonald TK, MacDonald G, Zanna MP, Fong GT. Alcohol, sexual arousal, and intentions to use condoms in young men: applying alcohol myopia theory to risky sexual behavior. Health Psychol. 2000 May;19(3):290–298. [PubMed]

33. Burian SE, Liguori A, Robinson JH. Effects of alcohol on risk-taking during simulated driving. Hum Psychopharmacol. 2002 Apr;17(3):141–150. [PubMed]

34. Cohen J, Dearnaley EJ, Hansel CE. The risk taken in driving under the influence of alcohol. Br Med J. 1958 Jun 21;1(5085):1438–1442. [PMC free article] [PubMed]

35. Waller JA. Research needs and opportunities concerning human-environmental interactions in crashes involving alcohol. J Stud Alcohol Suppl. 1985 Jul;10:54–60. [PubMed]

36. Kerr JS, Hindmarch I. The Efects of Alcohol Alone or in Combination with Other Drugs on Information Processing, Task Performance and Subjective Responses. Human Psychopharmacology. 1998;13:1–9.

37. Robbe H. Influence of Marijuana on Driving. Maastricht, The Netherlands: University of Limburg; 1994.

38. Smiley A. The Health Effects of Cannabis. In: Kalant H, editor. Marijuana: On-Road and Driving Simulator Studies. Toronto: Centre for Addiction and Mental Health; 1998.

39. Sutton LR. The effects of alcohol, marihuana and their combination on driving ability. J Stud Alcohol. 1983 May;44(3):438–445. [PubMed]

40. MacDonald S, Mann R, Chipman M, et al. Driving behavior under the influence of cannabis or cocaine. Traffic Inj Prev. 2008;9(3):190–194. [PubMed]

41. Robbe H, O'Hanlon J. Marijuana and actual driving performance. Washington, DC: US Department of Transportation, National Highway Traffic Safety Administration; 1993.

42. Marczinski CA, Harrison EL, Fillmore MT. Effects of alcohol on simulated driving and perceived driving impairment in binge drinkers. Alcohol Clin Exp Res. 2008 Jul;32(7):1329–1337. [PubMed]

43. Smiley A. Marijuana: On-road and driving simulator studies. Alcohol, Drugs and Driving. 1986;2(3–4):121–134.

44. Smiley A. Marijuana: On-Road and Driving Simulator Studies. In: Kalant H, Corrigal W, Hall W, Smart R, editors. The Health Effects of Cannabis. Toronto: Addiction Research Foundation; 1999. pp. 173–191.

45. Smiley A, Moskowitz H, Ziedman K. Driving simulator studies of marijuana alone and in combination with alcohol. Paper presented at: 25th Conference of the American Association for Automotive Medicine; 1981.

46. Klonoff H. Marijuana and driving in real-life situations. Science. 1974 Oct 25;186(4161):317–324. [PubMed]

47. Hansteen RW, Miller RD, Lonero L, Reid LD, Jones B. Effects of cannabis and alcohol on automobile driving and psychomotor tracking. Ann N Y Acad Sci. 1976;282:240–256. [PubMed]

48. Sexton B, Tunbridge R, Brook-Carter N, et al. The influence of cannabis on driving. Crowthorne, UK: TRL Limited; 2000.

49. Stein A, Allen R, Cook M, Karl R. A Simulator Study of the Combined Effects of Alcohol and Marijuana on Driving Behavior. Hawthorne, CA: Systems Technology, Inc; 1983.

50. Peck R, Biasotti A, Boland P, Mallory C, Reeve V. The effects of marijuana and alcohol on actual driving performance. Alcohol, Drugs and Driving: Abstracts and Reviews 1986. 1986;2:135–154.

51. Casswell S. Cannabis and alcohol: Effects on closed-course driving behavior. Paper presented at: 7th International Conference on Alcohol, Drugs, and Traffic Safety; 1979; Melbourne, Australia.

52. Dott A. Effect of marijuana on risk acceptance in a simulated passing task. Washington, DC: US Government Printing Office; 1971.

53. Ellingstad V, McFarling L, Struckman D. Alcohol, Marijuana and Risk Taking. Vermillion, DS: Vermillion Human Factors Laboratory, South Dakota University; 1973.

54. Crancer A, Jr, Dille JM, Delay JC, Wallace JE, Haykin MD. Comparison of the effects of marihuana and alcohol on simulated driving performance. Science. 1969 May 16;164(881):851–854. [PubMed]

55. Rafaelsen L, Christrup H, Bech P, Rafaelsen OJ. Effects of cannabis and alcohol on psychological tests. Nature. 1973 Mar 9;242(5393):117–118. [PubMed]

56. Moskowitz H, Hulbert S, McGlothlin W. Marijuana: Effects on simulated driving performance. Accid Anal Prev. 1976;8:45–50.

57. Casswell S. Cannabis and alcohol: Effects on closed-course driving behavior. Paper presented at: Seventh International Conference on Alcohol, Drugs, and Traffic Safety; 1977; Melbourne, Australia.

58. Kruger H. Low alcohol concentrations and driving. Bergisch Gladbach: Bundesanstalt fur Strassenwesen; 1990.

59. Berghaus G. Comparison of the effecvts of cannabis and alcohol from experimental studies. In: Grotenhermen F, Karus M, editors. Cannabis, Driving and Workplace. Heidelberg/New York: Springer Verlag; 2002. pp. 225–235.

60. Calhoun VD, Pekar JJ, Pearlson GD. Alcohol intoxication effects on simulated driving: exploring alcohol-dose effects on brain activation using functional MRI. Neuropsychopharmacology. 2004 Nov;29(11):2097–2017. [PubMed]

61. Jones RT, Stone GC. Psychological studies of marijuana and alcohol in man. Psychopharmacologia. 1970 Aug 19;18(1):108–117. [PubMed]

62. Marks DF, MacAvoy MG. Divided attention performance in cannabis users and non-users following alcohol and cannabis separately and in combination. Psychopharmacology (Berl) 1989;99(3):397–401. [PubMed]

63. Wright A, Terry P. Modulation of the effects of alcohol on driving-related psychomotor skills by chronic exposure to cannabis. Psychopharmacology (Berl) 2002 Mar;160(2):213–219. [PubMed]

64. Sexton B, Tunbridge R, Board A, Jackson P, Stark M, Englehart K. The influence of cannabis and alcohol on driving. Crowthorne, UK: Transport Research Laboratory; 2002.

65. Ramaekers JG, Robbe HW, O'Hanlon JF. Marijuana, alcohol and actual driving performance. Hum Psychopharmacol. 2000 Oct;15(7):551–558. [PubMed]

66. Bates MN, Blakely TA. Role of cannabis in motor vehicle crashes. Epidemiol Rev. 1999;21(2):222–232. [PubMed]

67. Drummer O. Inquiry into the effects o drugs (other than alcohol) on road safety in Victoria, Incorporating Selected Papers. Melbourne, Australia: LV North, Government Printer; 1995. A review of the contributions of drugs in drivers to road accident; pp. 1–28.

68. Terhune K, Ippolito C, Hendricks D, et al. The incidence and role of drugs in fatally injured drivers. Washington, DC: National Highway Traffic Safety Administration, U.S. Department of Transportation; 1992.

69. Drummer O. Drugs and accident risk in fatally injured drivers. Paper presented at: T95: 13th International Conference on Alcohol, Drugs and Traffic Safety; 1995; Adelaide, Australia.

70. Terhune K. An evaluation of crash culpability to assess alcohol and drug impairment effects. Paper presented at: 26th Annual Meeting, American Association for Automotive Medicine; 1982; Ontario, Canada.

71. Williams AF, Peat MA, Crouch DJ, Wells JK, Finkle BS. Drugs in fatally injured young male drivers. Public Health Rep. 1985 Jan-Feb;100(1):19–25. [PMC free article] [PubMed]

72. Lowenstein SR, Koziol-McLain J. Drugs and traffic crash responsibility: a study of injured motorists in Colorado. J Trauma. 2001 Feb;50(2):313–320. [PubMed]

73. Drummer O, Gerostamoulos J, Batziris H, Chu M, Caplehorn J, Robertson M. The involvement of drugs in drivers of motor vehicles killed in Australian road traffic crashes. Accid Anal Prev. 2004;36:239–248. [PubMed]

74. Laumon B, Gadegbeku B, Martin JL, Biecheler MB. Cannabis intoxication and fatal road crashes in France: population based case-control study. Bmj. 2005 Dec 10;331(7529):1371. [PMC free article] [PubMed]

75. Longo MC, Hunter CE, Lokan RJ, White JM, White MA. The prevalence of alcohol, cannabinoids, benzodiazepines and stimulants amongst injured drivers and their role in driver culpability: part ii: the relationship between drug prevalence and drug concentration, and driver culpability. Accid Anal Prev. 2000 Sep;32(5):623–632. [PubMed]

76. Jones AW, Holmgren A, Kugelberg FC. Driving under the influence of cannabis: a 10-year study of age and

gender differences in the concentrations of tetrahydrocannabinol in blood. Addiction. 2008 Mar;103(3):452–461. [PubMed]

77. Augsburger M, Donze N, Menetrey A, et al. Concentration of drugs in blood of suspected impaired drivers. Forensic Sci Int. 2005 Oct 4;153(1):11–15. [PubMed]

78. Grotenhermen F, Leson G, Berghaus G, et al. Developing limits for driving under cannabis. Addiction. 2007;102:1910–1917. [PubMed]

79. Papafotiou K, Carter JD, Stough C. The relationship between performance on the standardised field sobriety tests, driving performance and the level of Delta9-tetrahydrocannabinol (THC) in blood. Forensic Sci Int. 2005 Dec 20;155(2–3):172–178. [PubMed]

80. Simpson HM, Mayhew DR, Warren RA. Epidemiology of road accidents involving young adults: alcohol, drugs and other factors. Drug Alcohol Depend. 1982 Sep;10(1):35–63. [PubMed]

81. Simpson HM. Epidemiology of road accidents involving marijuana. Alcohol, Drugs and Driving. 1986;2:15–30.

82. Warren RA, Simpson HM, Hilchie J, Cimbura G, Lucas D, Bennett R. Drugs detected in fatally injured drivers in the Province of Ontario. In: Goldberg L, editor. Alcohol, Drugs and Traffic Safety. Stockholm, Sweden: Almqvist and Wiksell International; 1981. pp. 203–217.

83. Crouch DJ, Birky MM, Gust SW, et al. The prevalence of drugs and alcohol in fatally injured truck drivers. J Forensic Sci. 1993 Nov;38(6):1342–1353. [PubMed]

84. Terhune K. Problems and methods in studying drug crash effects. Alcohol, Drugs and Driving. 1986;2:1–13.

85. Hunter CE, Lokan RJ, Longo M, White J, White M. The prevalence and role of alcohol, cannabinoids, benzodiazepines and stimulants in non-fatal crashes. Adelaide, Australia: Forensic Science, Department for Administrative and Information Services; 1998.

86. Movig KL, Mathijssen MP, Nagel PH, et al. Psychoactive substance use and the risk of motor vehicle accidents. Accid Anal Prev. 2004 Jul;36(4):631–636. [PubMed]

87. Mathijssen MP, Movig KL, De Gier JJ, Nagel PH, van Egmond T, Egberts AC. Use of psychoactive medicines and drugs as a cause of road trauma. Paper presented at: 16th International Conference on Alcohol, Drugs and Traffic Safety T2002; 2002; Montreal, Canada.

88. Jones C, Donnelly N, Swift W, Weatherburn D. Driving under the influence of cannabis: The problem and potential countermeasures. Crime and Justice Bulletin. 2005;87:1–15.

89. Gerberich SG, Sidney S, Braun BL, Tekawa IS, Tolan KK, Quesenberry CP. Marijuana use and injury events resulting in hospitalization. Ann Epidemiol. 2003 Apr;13(4):230–237. [PubMed]

90. Mura P, Kintz P, Ludes B, et al. Comparison of the prevalence of alcohol, cannabis and other drugs between 900 injured drivers and 900 control subjects: results of a French collaborative study. Forensic Sci Int. 2003 Apr 23;133(1–2):79–85. [PubMed]

91. Dussault C, Brault M, Bouchard J, Lemire A. The contribution of alcohol and other drugs among fatally injured drivers in Quebec: some preliminary results. Paper presented at: 16th International Conference on Alcohol, Drugs and Traffic Safety T2002; 2002; Montreal, Canada.

92. Brault M, Dussault C, Bouchard J, Lemire A. The contribution of alcohol and other drugs among fatally injured drivers in Quebec: Final results. Paper presented at: T2004: 17th International Conference on Alcohol, Drugs and Traffic Safety; 2004; Glasgow, UK.

93. Bedard M, Dubois S, Weaver B. The impact of cannabis on driving. Can J Public Health. 2007 Jan-Feb;98(1):6–11. [PubMed]

94. Robbe H, O'Hanlon J. Marijuana and Actual Driving Performance. National Highway Traffic Safety Administration, U.S. Department of Transportation; 1993.

95. Presidential Commission on Drunk Driving. Final Report; Washington, DC: Government Printing Office; 1983.

96. Donovan JE, Jessor R. Structure of problem behavior in adolescence and young adulthood. J Consult Clin Psychol. 1985 Dec;53(6):890–904. [PubMed]

97. Fergusson DM, Horwood LJ. Cannabis use and traffic accidents in a birth cohort of young adults. Accid Anal Prev. 2001 Nov;33(6):703–711. [PubMed]

98. Blows S, Ivers RQ, Connor J, Ameratunga S, Woodward M, Norton R. Marijuana use and car crash injury. Addiction. 2005 May;100(5):605–611. [PubMed]

99. Fergusson DM, Horwood LJ, Boden JM. Is driving under the influence of cannabis becoming a greater risk to driver safety than drink driving? Findings from a longitudinal study. Accid Anal Prev. 2008 Jul;40(4):1345–1350. [PubMed]

100. Mann RE, Adlaf E, Zhao J, et al. Cannabis use and self-reported collisions in a representative sample of adult drivers. J Safety Res. 2007;38(6):669–674. [PubMed]

101. Kelly E, Darke S, Ross J. A review of drug use and driving: Epidemiology, impairment, risk factors and risk perceptions. Drug and Alcohol Review. 2004;23:319–344. [PubMed]

102. Bierness D, Simpson H, Williams A. Role of cannabis and benzodiazepines in motor vehicle crashes. Transportation Research Circular. 2006;E-C096:12–21.

103. Moskowitz H. Commentary on variability among epidemiological studies of drugs and driving. Transportation Research Circular. 2006;E-C096:36–40.

104. Portans I, White J, Staiger P. Acute tolerance to alcohol: changes in subjective effects among social drinkers. Psychopharmacoogy. 1989;97:365–369. [PubMed]

105. Cochetto D, Owens S, Perez-Reyes M, DiGuiseppi S, Miller L. Relationship Between Plasma Delta-9-Tetrahydrocannabinol Concentration and Pharmacologic Effects in Man. Psychopharmacoogy. 1981;75:158–164. [PubMed]

106. Huestis M, Henningfield J, Cone E. Blood cannabinoids. I. Absorption of THC and formation of 11-OH-THC and THCCOOH during and after smoking marijuana. J Anal Toxicol. 1992;16(5):276–282. [PubMed]

WORLD ANTI-DOPING AGENCY
play true

New Threshold Level for Cannabis

At its May 11 meeting WADA's Executive Committee decided to increase the threshold level for cannabis following consideration of the many submissions received from stakeholders during the Code review process.

Accordingly, the Technical Document on **Decision Limits for the Confirmatory Quantification of Threshold Substances (//www.wada-ama.org/en/Documents/World_Anti-Doping_Program/WADP-IS-Laboratories/Technical_Documents/WADA-TD2013DL-Decision-Limits-for-the-Confirmatory-Quantification-Threshold-Substances-2.0-EN.pdf)** (TD2013DL) has been revised to reflect the applicable modifications affecting compliance decisions for Carboxy-THC.

Version 2.0 of the TD2013DL (//www.wada-ama.org/en/Documents/World_Anti-Doping_Program/WADP-IS-Laboratories/Technical_Documents/WADA-TD2013DL-Decision-Limits-for-the-Confirmatory-Quantification-Threshold-Substances-2.0-EN.pdf) is effective as of May 11, 2013, and can be found on **WADA's Web site (//www.wada-ama.org/en/Science-Medicine/Anti-Doping-Laboratories/Technical-Documents/)**.

All samples received by laboratories post-May 11 will be subject to the new threshold level.

As a matter of fairness and to provide consistency, WADA advises not to pursue cases currently in the results management phase where the reported concentration is less than the new threshold (150 ng/mL).

Also, for any analyses conducted from May 11 onwards, laboratories are requested not to report any THC case result below the acceptable threshold, regardless of the sample receipt date.

HOUSE SUBSTITUTE FOR

SENATE BILL NO. 72

A bill to amend 2008 IL 1, entitled

"Michigan medical marihuana act,"

by amending section 7 (MCL 333.26427).

THE PEOPLE OF THE STATE OF MICHIGAN ENACT:

7. Scope of Act.

Sec. 7. (a) The medical use of marihuana is allowed under state law to the extent that it is carried out in accordance with the provisions of this act.

(b) This act ~~shall~~ **DOES** not permit any person to do any of the following:

(1) Undertake any task under the influence of marihuana, when doing so would constitute negligence or professional malpractice.

(2) Possess marihuana, or otherwise engage in the medical use of marihuana **AT ANY OF THE FOLLOWING LOCATIONS**:

(A) ~~in~~ **IN** a school bus. ~~;~~

(B) ~~on~~ **ON** the grounds of any preschool or primary or secondary school. ~~; or~~

(C) ~~in~~ **IN** any correctional facility.

(3) Smoke marihuana **AT ANY OF THE FOLLOWING LOCATIONS:**

(A) ~~on~~ **ON** any form of public transportation. ~~; or~~

(B) ~~in~~ **IN** any public place.

(4) Operate, navigate, or be in actual physical control of any motor vehicle, aircraft, or motorboat while under the influence of marihuana.

(5) Use marihuana if that person does not have a serious or debilitating medical condition.

(c) Nothing in this act shall be construed to require **ANY OF THE FOLLOWING:**

(1) A government medical assistance program or commercial or non-profit health insurer to reimburse a person for costs associated with the medical use of marihuana.

(2) An employer to accommodate the ingestion of marihuana in any workplace or any employee working while under the influence of marihuana.

(3) A PRIVATE PROPERTY OWNER TO LEASE RESIDENTIAL PROPERTY TO ANY PERSON WHO SMOKES OR CULTIVATES MARIHUANA ON THE PREMISES, IF THE PROHIBITION AGAINST SMOKING OR CULTIVATING MARIHUANA IS IN THE WRITTEN LEASE.

(d) Fraudulent representation to a law enforcement official of any fact or circumstance relating to the medical use of marihuana to avoid arrest or prosecution ~~shall be~~ **IS** punishable by a fine of

$500.00, which ~~shall be~~ **IS** in addition to any other penalties that may apply for making a false statement or for the use of marihuana other than use undertaken pursuant to this act.

(e) All other acts and parts of acts inconsistent with this act do not apply to the medical use of marihuana as provided for by this act.

Enacting section 1. This amendatory act takes effect 90 days after the date it is enacted into law.